Department of Transportation
Federal Aviation Administration
Aircraft Certification Service
Washington, DC

TSO-C119b

Date: 12/18/98

Technical Standard Order

Subject: **TSO-C119b, TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) AIRBORNE EQUIPMENT, TCAS II**

1. PURPOSE. This technical standard order (TSO) prescribes the minimum performance standard that Traffic Alert and Collision Avoidance System II (TCAS II) equipment must meet in order to be identified with the applicable TSO marking.

2. APPLICABILITY. The standards of this TSO apply to the TCAS II system intended to be used in aircraft to provide a reliable aircraft collision avoidance function between transponder-equipped aircraft.

3. REQUIREMENTS. Equipment that is to be identified with the applicable TSO marking must meet the minimum performance standards set forth in Section 2 of RTCA, Inc. (RTCA) Document No. DO-185A, "Minimum Operational Performance Standards for Traffic Alert and Collision Avoidance System II (TCAS II) Airborne Equipment," dated December 16, 1997, with the exceptions listed in Appendix 1 of this document.

a. Failure Condition Classification. Failure of the intended function(s) defined in paragraph 2 of this TSO has been determined to be a Hazardous/Severe-Major failure condition. The applicant must develop traffic alert and collision avoidance system II equipment to at least the design assurance level commensurate with this failure condition classification.

b. Functional Qualifications. Functional testing shall be in accordance with RTCA Document No. DO-185A, dated December 16, 1997 and appropriate changes listed in Appendix 1 of this document.

c. Environmental Qualification. The equipment shall be subject to the test conditions as specified in Section 2 of RTCA Document No. DO-185A, dated December 16, 1997, except that RTCA Document No. DO-160D, "Environmental Conditions and Test Procedures for Airborne Equipment," dated July 29, 1997, shall be used instead of DO-160C.

d. Software Qualification. If the article includes software, the software must be developed in accordance with RTCA/DO-178B, "Software Considerations in Airborne Systems and Equipment Certification," dated December 1, 1992. Those articles containing software upgraded from an original product, compliant with the process described in DO-178A, "Software

considerations in Airborne Systems and Equipment Certification," published in 1985 need only apply the requirements in DO-178B to changed software and all software affected by the change. A change analysis must be performed to clearly identify the components affected by the change. Section 12 of DO-178B, Additional Considerations, must be consulted for further guidance on previously developed software.

e. Deviations. Some minimum performance standards include provisions for alternative or equivalent means of compliance to the criteria set forth in the standard. In such cases, applicants invoking these provisions shall apply for a deviation in accordance with 14 CFR 21.609.

4. MARKING. In accordance with the markings specified in 14 CFR 21.607(d), the following requirements apply to all separate components of equipment that is manufactured under this TSO.

a. Major Component. At least one major component must be permanently and legibly marked with all of the information listed in 14 CFR 21.607(d).

b. Separate Component. In addition, each separate component of equipment must be permanently and legibly marked with at least the name of manufacturer, manufacturers part number, and the TSO number.

c. Software. If the component includes dataloadable software, the part number must include a hardware and software identification. Separate part numbers may be utilized for hardware and software. The part number must uniquely identify the hardware and software design, including modification status.

d. Article Function. When applicable, identification that the article is an incomplete system, or that the article accomplishes additional functions, must be provided.

5. DATA REQUIREMENTS.

a. Application Data. In accordance with 14 CFR Part 21.605(a)(1) and (3), the manufacturer must furnish the Manager, Aircraft Certification Office (ACO), Federal Aviation Administration (FAA), having purview of the manufacturer's facilities, one copy each of the following technical data to support the FAA design and production approval:

(1) Operating instructions and equipment limitations. The limitations shall be sufficient to describe the operational capability of the equipment.

(2) Installation procedures and limitations. The limitations shall be sufficient to ensure that the appliance, when installed in accordance with the installation procedures, continues to meet the requirements of this TSO. The limitations shall also be sufficient to identify any unique aspects of the installation. The limitations shall include at least the following:

(a) a note with the following statement: "The conditions and tests required for TSO approval of this article are minimum performance standards. It is the responsibility of those installing this article either on or within a specific type or class of aircraft to

determine that the aircraft installation conditions are within the TSO standards. The article may be installed only if the installation is performed in accordance with the applicable airworthiness and production requirements."

(b) when applicable, identification that the appliance is an incomplete system, or accomplishes additional functions beyond that described in paragraph 2. This must describe the functions that are intended to be provided by the appliance.

(3) Schematic drawings as applicable to the installation procedures.

(4) Wiring diagrams as applicable to the installation procedures.

(5) Equipment specifications.

(6) List of the components (by part number) that make up the equipment system complying with the standards prescribed in this TSO.

(7) Instructions for periodic maintenance and calibration which are necessary for continued airworthiness once the equipment is installed.

(8) An environmental qualifications form as described in RTCA/DO-160D for each component of the system.

(9) Manufacturer's TSO qualification test report.

(10) Nameplate drawing.

(11) Statement of software verification and validation levels as defined in RTCA/DO-178B.

(12) The appropriate documentation as defined in RTCA/DO-178B, or equivalent, necessary to support the verification and validation of the computer software to the appropriate level(s). If the software is verified and validated to more than one level, the appropriate documentation for all such levels must be submitted.

(13) A Plan for Software Aspects of Certification (PSAC); Software Configuration Index; and Software Accomplishment Summary is needed if the article includes software.

NOTE: The FAA recommends that the PSAC be submitted early in the software development process. Early submittal will allow timely resolution of issues such as partitioning and determination of software levels.

b. Data that must be available upon request. In addition to those data requirements that are to be furnished directly to the FAA, each manufacturer must have available for review by the manager of the ACO having purview of the manufacturer's facilities, the following technical data:

(1) The functional test specifications to be used to test each production article to ensure compliance with this TSO.

(2) Equipment calibration procedures.

(3) Corrective maintenance procedures (within 12 months after TSO authorization).

(4) Schematic drawings.

(5) Wiring diagrams.

(6) The results of the environmental qualification tests conducted in accordance with RTCA/DO-160D.

(7) If the article includes a digital computer, the appropriate documentation as defined in RTCA/DO-178B, including all data supporting the applicable objectives found in Annex A of RTCA/DO-178B, Process Objectives and Outputs by Software Level.

c. Data to be Furnished with Manufactured Units.

(1) One copy of the data and information specified in paragraphs 5(a)(1) through (8) of this TSO must be provided to each purchaser of one or more articles manufactured under this TSO.

6. AVAILABILITY OF REFERENCED DOCUMENTS

a. Copies of RTCA Document Nos. DO-160D, DO-178B, and DO-185A may be purchased from the RTCA Inc., 1140 Connecticut Avenue, N.W., Suite 1020, Washington, D.C. 20036-4001.

b. Federal Aviation Regulations Part 21, Subpart O, may be purchased from the Superintendent of Documents, Government Printing Office, Washington, DC 20402-9325.

c. AC 20-110 (current revision), "Index of Aviation Technical Standard Orders" may be obtained from the U.S. Department of Transportation, Subsequent Distribution Office, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785.

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APPENDIX 1. Changes to RTCA/DO-185A, "Minimum Operational Performance Standards for Traffic Alert and Collision Avoidance System II Airborne Equipment (TCAS II)

The list below includes the contents of the CD-ROM titled "TSO C119B Changes to DO-185A, *Approved by SC-147 RWG" dated* December 4, 1998.

Change Proposals 1-92: These change proposals were submitted by the aviation community after the original Minimum Operational Performance Standards (MOPS) referenced in this TSO were published. The resolution of these change proposals is reflected in the following and, with RTCA/DO-185A, constitute the design approval for TCAS II version 7.0.

Test Suite: The files found within the folders "inputs" and "outputs" are for running the CAS tests described in Volume I of DO-185-A (section 2.4.2.2). These tests will be used in the certification process of DO-185A compliant TCAS.

Inputs: The "inputs" file is the test definition.

Outputs: The "outputs" file is the expected results.

Transitions: The "transitions" file is an intermediate output file that can be used to help determine why the expected results are not being produced.

TSIM: TSIM is a verified implementation of the CAS specifications defined in Volume II of RTCA/DO-185A. TSIM can be useful in the design and test of other TCAS implementations.

CAS Requirements Specification (Crs12_98.pdf): This file contains changes to Volume II of RTCA/DO-185A. Volume II presents the required collision avoidance algorithms in a state chart formulation with informational commentary text.

Pseudocode (PCODE119.pdf): This file contains changes to Attachment A of RTCA/DO-185A. Attachment A is a verified implementation of the CAS specifications defined in Volume II. It is commonly referred to as simply "the pseudocode".

Volume 1 RTCA/DO-185A (V1Change.pdf): This file contains changes to Volume I of RTCA/DO-185A. Volume I provides version 7.0 of the TCAS II Logic and sets forth the minimum operational performance standards for TCAS II equipment.

Requests for information concerning hardware/software requirements should be directed to: Federal Aviation Administration, William J. Hughes Technical Center, Aircraft/Avionics Branch (ACT-370), (609) 485-4658